Knee Surgery, Sports Traumatology, Arthroscopy (2018) 26:1303–1304
https://doi.org/10.1007/s00167-018-4886-6

EDITORIAL

Let us rethink research for ACL injuries: a call for a more complex scientific approach

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Received: 8 January 2018 / Accepted: 28 February 2018 / Published online: 5 March 2018


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The complex anatomy and function of the knee have been well recognized [5]. Understanding and explaining a complex biological system such as the knee joint are often difficult and challenging. To overcome the problem of complexity, many scientists simplify or reduce this complexity by disassembling the complex system into their single units. However, the knee joint is not a simple machine put together by bones, muscles, and connective tissue. Importantly, clinicians do not treat knees, but a person who has a knee problem.

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Reductionism has been the basis of most scientific fields, and has led to an impressive range of discoveries and advancements.

How can we apply this to enhance our understanding of prevention and treatment of various knee pathologies? To understand how the knee joint works, one could dissect the knee and place all soft tissue and bony parts on a counter top. Looking now at the patella and the popliteal artery, does this gives us an idea how the knee joint functions as a whole? It appears that a reductionistic approach is also widely used in ACL research, in particular when aiming for identification of isolated risk factors for ACL injuries [1]. Given that ACL injuries are multifactorial in nature, limitations of univariate analysis of ACL injury have been reported [6].

In contrast to reductionism, a complex systems theory is a field of science studying how parts of a system give rise to the collective behaviors of the system, and how the system interacts with its environment in the broadest sense [4]. A complex system approach that highlights a non-linear interaction between risk factors from different scales (biomechanical, psychological and physiological characteristics) [2]. Risk factors and their interactions are often unknown and the direct relationship with the injury is weak or even non-existent. Only in case of an inciting an injury may occur [2]. In other words, ACL prevention research should focus on the analysis of the observable regularities arising from the existing and complex interactions among the elements of the web of determinants and not the units (risk factors) themselves [2].

In case of an ACL reconstruction, one could argue that a part in the human machine has been replaced (ACL graft), and subsequently, the machine should function normally again. Another view could be, in analogy to a car, that patients after ACL reconstruction have rebuilt transmissions and these are not the same as the factory transmissions (native ACL) [3]. In contrast to cars, humans form a biological system with an inherent capability to adapt to changes. This is also where the complexity lies, as large inter-individual differences may arise as to how humans respond to these changes.

Some patients may indeed return to normal function and achieve their full potential and participate (sports, work) at the same level as before the injury. Others, however, have to reduce their activity.

A patient should be viewed as a complex system with non-linear relationships between units (i.e., biomechanical, behavioural, physiological, and psychological factors) that give rise to the collective behaviour of the athlete [2].

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